Miles Beale Esq
With the Author's Compliments

INTRODUCTORY

(4)

ADDRESS

DELIVERED AT THE

MIDDLESEX HOSPITAL

ON THE OPENING OF THE

WINTER MEDICAL SESSION OF 1850-51.

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M.DCCC.LI.

ADDRESS.

GENTLEMEN—

To me has been deputed the honour of giving the introductory address on the opening of the winter session at this school. Although fully sensible of the honour conferred upon me by my colleagues in requesting me to give the address on this occasion, yet I must confess that it was with some regret that I complied with it, from a feeling that I could not give that attention to its preparation which I should have liked, in consequence of a peculiar claim on my time and attention at this period. It was expected that the learned senior physician of this hospital would have obliged us on this occasion; and it was with very deep regret that the lecturers found that, in consequence of the pressure of his other avocations, he would be unable to accede to their request. His superior learning, his large experience, and his far longer connexion with this school, would have enabled him to give an address much more acceptable to this meeting than one coming from so humble an individual as myself, whose connexion with the school has been so recent. I have, however, one great encouragement, in the sympathy felt, I hope, by all present in the success of this school, and especially by the body of governors of thir hospital, and that whatever may be my failings on this occasion, theis interest in the school will continue unabated. The history of this school during the past few years presents a very varied character. From causes, which happily no longer exist, its prosperity was for some time declining, but within the last two or three years it has again risen into vigour, and has been successful to an extent which its most sanguine well-wishers could scarcely have ventured to anticipate. The history of the past will be, I hope, as it ever ought to be in every institution, our safest guide for the future; and so long as we avoid the shoals and quicksands which have been so disastrous in former times, and keep steadily in the smooth and even stream of unanimity, honour, and industry, there can be no one reason why the Middlesex Hospital School should be second to any in this metropolis. We have a noble hospital, the zealous support of the governors, and our dissecting-rooms, museums, and other appliances, are equal to those of most other medical schools; and, with a strict and unswerving determination on the part of all concerned in its management to keep up a high tone of moral and gentlemanly feeling in our pupils, and to encourage industry in their studies, what should prevent the Middlesex Hospital School from ranking among the first in London! There is, however, one ingredient wanting which has successfully been introduced into a few other schools, and which has been found to have answered the high purpose which it was intended to fulfil. I need scarcely say, that I allude to the collegiate principle, like that which has been for so long a period in operation in our time-honoured universities. And although it might, perhaps, be considered premature at once to form such an establishment, yet it is considered by those who have the interests of the school—and I may add, those of medical pupils also—most deeply at heart, that its

introduction, at no very distant period, should be kept steadily and constantly in view. No one who has reflected much on the mode in which medical education has hitherto been conducted in this country, and on the manner in which pupils have been thrown on their own resources on arriving in London, and in prosecuting their studies, can have failed to perceive a very great and serious defect. Lectures have too often been the only means of communication between teacher and pupil, and the amount of information possessed by the latter, or the progress made in his studies, whether little or much, has, in the majority of cases, been wholly unknown to the lecturer. This, it must be evident to every one, is not the relation which ought to exist between teacher and pupil. The lecturer should be a tutor, seeing not only that the pupil is regular in his attendance on the lectures, but that he reads the subjects at home; and his knowledge of them should be tested by frequent examinations. Again, the want of suitable apartments for quiet study is deeply felt by students, and to those who mix much with them this is plainly evident. It is often seen that a young man who has been carefully and anxiously brought up by his parents, is sent to London from a comfortable home, in which all the duties of a family have been strictly and regularly observed. The school to which he is to enter may or may not have been selected for him; if it has not, his difficulties are still more increased. He comes, perhaps, without a single introduction, and the first thing, after selecting his school, is to look for a lodging. In this selection he is entirely without a guide. Generally, such lodgings as fall within the means of a medical pupil's resources are not at all adapted for study, and, for the most part, kept by a class of persons into whose house his parents would but little have liked him to enter—a class quite incapable of appreciating the conditions necessary for quiet and successful study, as well as the wants and exigencies of a gentleman. In effect, their houses are, for the most part, noisy and comfortless, and, in many respects, are calculated rather to divert a pupil from his studies, than to encourage him to pursue them. The consequence is, what lecturers often find to be the case, that, instead of reading and reflecting at their homes on the subjects daily brought before them, too many of the pupils trust entirely to the impression made in the lecture-room, and the whole subject is left out of mind until another lecture on the same subject again brings it before them. The lodgings in which they are located are so unlike the homes that they have lately left, and have always been accustomed to, that they are glad to be absent from them, and too often are lured from their studies by temptations to amusements which are profitable neither in an intellectual nor in a moral point of view.

Such is an unexaggerated statement of a case which is too often witnessed, and which the collegiate principle is intended to remedy—the great object being to provide comfortable and quiet apartments for the pupils, under the control of the weekly board, or some one appointed by it; to provide commons at a reasonable rate, and thereby prevent the necessity of their going to chop-houses and other similar places for their meals; and, moreover, and above all, to secure, on the tutorial system, constant advice and assistance in the prosecution of their studies. These are the objects sought to be accomplished by the collegiate system; and to any one even but little acquainted with the mode of living and the habits of a good many medical pupils—there are, I am glad to say, many, very many honourable exceptions around me,—to any one, I repeat, who has witnessed their habits generally, it must be apparent that some sacrifices and trouble might well be incurred for the attainment of such desirable results. The

governors of this hospital have already done a great deal to remedy this state of things. They insist on a regular attendance on lectures, and have taken means for securing it; and they have also made arrangements, which have been now in operation for some time, for those pupils who like it, to take their meals with the officers of the hospital. These are very important steps in the right direction, and are only two among many acts in which the governors of this hospital have evinced their lively interest in the school and in the comfort and welfare of the pupils. It is not the interest and welfare of medical pupils that are alone to be promoted by the collegiate system, it is not the medical profession that is to be advanced, but the welfare and safety of the public generally are deeply and vitally concerned in every thing which is calculated to exert an influence on the character and education of medical men, and of that which promotes their honour and intelligence; and as the collegiate system will be a powerful engine in securing and advancing these, it would, I think, be impossible to over-estimate its importance. The public is but little aware how much it is dependent on the honourable conduct of members of the medical profession, or of the great temptation which it holds out for departing from an upright and honourable course in the practice of the profession. The rage which at this time more than ordinarily prevails among the public for the removal of disease by so-called specifics, or by exclusive and partial modes of practice, holds out a great temptation to medical men to give up the honourable and honest practice of their profession for the more money-getting but dishonest course of quackery and deception. It is observed with deep regret that this temptation is too strong for some, whose early moral training has been neglected, or whose moral and religious feelings are too feeble to resist it. Were the public better informed of the legitimate practice of medicine, of the object which is sought to be fulfilled in the treatment of disease by right-minded and well-educated members of the profession, very few would be the dupes and victims of those designing and dishonest persons who set themselves up as mesmerists, hydropathists, and homœopathists, who would appear to prosper by deceiving the public as to what constitutes the regular practice of the profession, and, under pretence of an exclusive system, still continue to treat disease on the very plan which they profess to condemn. If it were known to the public, that the great and only object sought to be secured by the medical corporate bodies, in the curricula of study which they have framed, was to insure, on the part of those applying for their licence, an accurate knowledge of disease in all its phases, and the application of *all* remedial agents, both external and internal, which science and experience have sanctioned, and not to recommend or force upon medical men any one partial or exclusive plan of treatment, the public would soon cease to be deceived by these dishonest persons, and exhibit less credulity in their misrepresentations. It is a mistake to suppose that medical men are interested in one plan of treating disease more than another; they are not so. Their only object is, first, accurately to determine the character of the morbid action set up, and, this being done, with all the aid of direct and collateral means of research, then to apply every remedy which science and experience point out. They have no interest in excluding *any plan of treatment* which is based on scientific and well-defined principles, and will bear the test of experience; but, as members of the commonwealth, they *are* interested in protecting their fellow-countrymen from the injuries to which they are exposed by the misrepresentations and malpractices of unprincipled adventurers.

It appears to me that our profession is in a wrong position with regard

to the public intellectually, socially, and politically. The public generally is unacquainted with the nature and extent of medical education, and with the present state of medical science; it regards medical men too often as actuated by selfish interests, and not as friends who have, as a body, done more for the cause of humanity than any other class of men; and, in a political point of view, they are excluded from honours and emoluments to which the other learned professions have free access. It was only on the last northern circuit that a barrister, a Queen's serjeant, in open court, spoke of medicine as a science, with a recklessness and contempt, which show that he must either have been utterly and blindly ignorant of what he spoke, or (what is more likely, as he was himself educated for the profession in his early life) he must have been guilty of a moral delinquency of a very grave character.

Upon occasions like the present, it is very difficult to fix upon a subject which presents any features of novelty, which has not in fact been dilated upon with a tedious repetition. I do not know that the history of the progress of physiology and medicine during any particular period has ever formed one of these subjects; but whether it has or not, believing that in a mixed assemblage like the present, it might be the means of placing the scientific nature of medical studies in a prominent point of view, I have decided upon directing your attention on this occasion to the principal discoveries which have been made in physiology during the past quarter of a century, and their influence on the principles and practice of medicine and surgery. I hope to make it clear, that the science of medicine is as exact, and the phenomena of the vital actions in health and in disease are as well understood, as are those of any of what are called the natural sciences.

It is an undoubted fact, that during the last quarter of a century the progress of medical science, used in its most extended signification, has been greater than at any other similar antecedent period; and yet, notwithstanding that the last few years have teemed with discoveries of the greatest value, not one of them has attracted much attention from the public. An eminent writer has stated, that this perhaps is not so remarkable, considering the apathy that prevails among the general public in all that relates to the medical profession; and most unhappy is it for the highest interests of society that it is so;—that the great discoveries, both in physiology and anatomy, which are crowded within the last quarter of a century, have attracted so little notice among the educated and learned classes. And yet it would not be difficult to show, that, within the space of these few short years, the whole aspect of organic science has been changed; that discoveries, in no degree second in intrinsic importance to that of the circulation, have been made, casting a flood of light on the most universal phenomena of animal bodies; that generalizations relating both to properties and laws, having a value and signification in the organic creation so vast that they can only be properly compared with those of gravitation or chemical affinity in the domain of common matter, have been firmly established; that whereas, till within a period so brief that it is as nothing in the ordinary calculations of human progress, there was scarcely a prime question, whether relating to structure or function, which was not either unknown or involved in doubt, there are not a few on which a mass of knowledge is now possessed, which, even by the most sanguine, must have been hoped for rather as the fruits of centuries than of years. It may reasonably be asked to what this rapid progress is due. I believe it may be mainly ascribed to the more active and more scientific cultivation of general or minute anatomy.

The more substantial foundation on which scientific medicine now rests, and the sounder principles of the practice of medicine now in vogue, are eminently due to the important discoveries which have been made in organic science within the past twenty years. I do not think it an exaggeration to say, that, previously to this epoch, all relating to minute anatomy and physiology was involved in doubt and obscurity, and that the practice of medicine partook of this doubtful and uncertain character. It is quite true that there have appeared, from time to time, great men, who have been so far in advance of the age in which they lived, that their views were imperfectly comprehended, and their labours and writings left in neglect. Among these may be mentioned the ever-honoured name of Hunter; for, as has been truly observed, "amidst the innumerable additions which have from all quarters flowed in, there are scarcely any which do not find their place among the great principles enunciated by him; while not a few of the most profound discoveries, equally with the most minute, are but the repetitions of great truths, which he had long since proclaimed in a language now become clear and expressive."*

The great discoveries which have been made by modern investigation may be traced, to a very great extent, to the improvements effected in the construction of optical instruments, and to the extensive use of the microscope in the study of minute anatomy; and, in saying this, I would not be considered as doing an injustice to another most valuable means which has been resorted to in the same kind of investigations: I allude to organic chemistry. These two most potent means have been instrumental in effecting a complete revolution in physiological science; and this is so generally known and felt in the present day, that there is no probability of their ever being withdrawn from anatomical and physiological investigations. Indeed, a navigator would as soon be found to traverse the ocean without a chart and compass, as the anatomist and physiologist to thread his way through the intricacies of organization without the aid of the microscope and chemical analysis. It is necessary for them to go together, for where chemistry fails there the microscope has been found effectual, as in detecting and tracing the wonderful phenomena of generation and development; and, where the microscope has been found inefficient, then we have been assisted out of the difficulty by chemistry, as in the explanation of the changes effected on the blood by respiration; and in many other cases these great auxiliaries are found going hand in hand together, mutually proving and confirming the truths revealed by each. The examples of this are so numerous and patent as to render it unnecessary for me to point them out in an assemblage like the present.

In taking a review of the progress of physiological and medical science during the last quarter of a century, the first in point of time, if not in importance, which will come under our consideration, is that which has taken place in our knowledge of the nervous system. Our knowledge of this system appears to have been altogether built up during this period; indeed, it may truly be said, that every fact of importance connected with it has been brought to light, and that all we know of this system has originated and been discovered within the past twenty-five or thirty years. For these great discoveries, which have formed a new era in medical diagnosis, and the importance of which to the physician and surgeon can scarcely be overrated, we are indebted principally to the labours and genius, in our own country, (among many others who have furnished many valuable contributions,) of a Bell, a Hall, and a Reid; and abroad, to those of Müller, Flourens, Valentin, and others. But the first, and pre-eminent,

* Grainger.

is Bell, whose genius shed a lustre, not only on this school (which will ever be honoured in having had such a man attached to it), but on the country which gave him birth. He it was who, without any exaggeration, may be said to have extricated our knowledge of this system from a mass of confusion, and raised it to a clear and intelligible position. Before the brilliant idea which he conceived of the nervous system, every thing was dark and undefined. Mr. Shaw, in his narrative of Sir C. Bell's discoveries, states that, before his time, "It was taken for granted, that all parts of this system had certain general properties belonging to them in common, so that all were considered alike in function. The brain, including the spinal marrow, was looked upon as a common store, from which certain powers, such as that of motion, were issued to the body, and into which others, such as sensation, were received, the nerves being regarded as the conductors; and, in conformity with that view, it was further supposed, that any part of the brain, or any single nerve, had equal power with all the others in bestowing the numerous properties commonly assigned to the nervous system." For the sake of illustration, we may take the nerves which arise from the spinal marrow. "It was conceived that these nerves were all simple in structure, and that nevertheless, they had the double property of conveying the power of motion and of sensation to the limbs; and the spinal marrow, being considered as a prolongation of the brain, was believed to transmit the powers of motion and of sensation along the nerves, by all its parts promiscuously." Such were the confused notions that prevailed when Sir C. Bell conceived the happy idea, which he afterwards proved to demonstration, that nerves were endowed with distinct and appropriate functions, corresponding with the parts of the brain and spinal marrow with which they are connected at their roots; and that when a nerve which appears simple is found to bestow more than one endowment, it is a sign that that nerve has more than one origin from the brain, and consists in reality of several nerves joined together. But it was not alone upon the origin and functions of compound nerves that he threw a light, but also on the nerves of special sense,—as the optic, auditory, olfactory, &c. "The nerves of special sense," says Mr. Shaw, "were formerly conceived to be so closely allied to each other, that their functions were regarded rather as modifications of one common property than as distinct and specific. Thus, it was supposed that the nerve of one organ of sense could be substituted for the nerve of another, if transposed to that organ. For example, it was believed that the optic nerve, on which vision depends, could bestow common sensation, or pain, like a nerve of the skin, and that a common sensory nerve might convey the special sensation of light." Sir C. Bell proved the error of this, and found that the nerves of special sense could only convey the peculiar sensation of light, sound, or smell, as respectively the case might be. Thus did this great man conceive, and that by a process of reasoning of the highest order, confirmed by his observation of the progressive development of the brain, from the lowest creatures upwards in the animal scale, this fundamental principle, which, to use the words of Mr. Shaw, "by adopting as his guide, he was rewarded, not only by making discoveries for their extent and value to medical science only to be compared with those introduced by Harvey by his discovery of the circulation; but he was rewarded also by communicating a fresh impulse to the labours of other physiologists in the same field." He saw, with his mental eye, what has been since proved to demonstration by the bodily organ, when aided by that second optical sense—the microscope—that the nerve which we trace in the body is made

up of a large number of parts, each having its distinct origin in the nervous centre, and taking a distinct and separate course throughout its extent. In this respect, again, he may be compared to the illustrious Harvey; for, as it has been well observed by an able physiologist, who has himself enriched anatomical and physiological science by his researches (Grainger), "neither Harvey nor Bell saw with the bodily organ the great cardinal facts they so confidently proclaimed,—the junction, that is to say, in the one case, of the arteries and the veins by means of the capillary vessels—that subtle link in the circle of the blood; and, in the other, the individuality of the primary nervous tubules." Some of the practical results of Sir C. Bell's discovery of the distinct function of nerves, extended and amplified as it has been by the labours of Arnold, Scarpa, Bischoff, Valentin, and Dr. J. Reid, may best be stated in Sir C. Bell's own words. Alluding to the discovery of the distinct and separate functions of the facial and the fifth pair of nerves, he says, "This discovery must prove useful both to the surgeon and physician. To the surgeon it must be useful in performing operations on the face, as well as in observing the symptoms of disease. If we have to plan an incision on the face, we must take especial care to avoid cutting the branches of the seventh nerve; for if it be divided, there will be a paralysis of the muscles supplied by that nerve. Whereas, if we divide the fifth, though there may be more pain during the operation, and a defect of sensibility following it, no unseemly distortion will be produced. To produce paralysis, as a consequence of an operation which was meant to remove a deformity, is an unfortunate mistake; but even worse consequences may result from an ignorance of the distinct nature of these nerves; if, trusting to the eyelids being supplied by the branches of the fifth nerve, a surgeon, on opening an abscess, or cutting out a tumour, should cut the division of the seventh, which goes to the eyelids, the consequences would be unfortunate. The eyelids thenceforward would stand apart, the eye would be permanently uncovered and inflamed, and from this inflammation the cornea become opaque, and the vision of the eye injured or altogether lost. By a knowledge of the distinct functions of the nerves of the face, combined with a knowledge of their roots or origins in the brain, we become better able to comprehend symptoms when they are consequent on disease in the bones, or in the base of the brain, or when they result from injury to the skull or brain, as in the case of gun-shot wounds."

To the physician, the facts ascertained in this paper must also be important. He will be better able to distinguish between that paralysis which proceeds from the brain, and that partial affection of the muscles of the face, when, from a less alarming cause, they have lost the controlling influence of the respiratory nerve. How often has an inflamed gland affecting a branch of the *portio dura* been mistaken for a disease in the brain itself, because it was not known that, although the fifth nerve was free, the pressure on the seventh nerve was sufficient to paralyse the muscles of the side of the face. That the disease of the bone at one time affects the fifth nerve, producing excessive pain of the face *without* paralysis, and that it, at another time, affects the seventh nerve, inducing paralysis *without* pain, are now phenomena accounted for. Again, it frequently occurs, that young people have what is vulgarly called a blight from exposure to cold, by which is meant a slight palsy of the muscles of one side of the face. Inflammation of glands, also, seated behind the angle of the jaw, will sometimes produce this. Before these observations of Sir C. Bell, it would have been said, that paralysis could *not* be so produced, *because the parts are plentifully* supplied by the branches of

the fifth nerve; that the disease must be in the brain. Cases of this kind are constantly occurring, which give a great value to Sir C. Bell's discoveries; and many other important results might be adduced, did time permit me to enter further into detail. I have purposely related Sir C. Bell's own description of the results of one of his very important discoveries, because to my medical hearers the statements contained in this description are now so commonly observed and generally understood, that it must appear surprising that, in so brief a period from this time, they were altogether new; and some medical men, indeed, there were who could not, or would not, believe them.

The next great discovery in the nervous system, for the light it throws on practical medicine and surgery, is even still more valuable than that of Sir C. Bell—I allude to that relating to the true and distinct function of the spinal cord. I have already said, that previous to Sir C. Bell's discoveries, the spinal cord was held to be merely a prolongation of the brain, and endowed with common properties with it. It was long regarded as no more than a bundle of nerves, or one large nerve, I may say, proceeding from the brain, and emerging at various points of the vertebral canal, to be distributed to their destined regions. The large amount of vesicular matter, and its varying quantity, according to the bulk of its segments, were entirely overlooked.

Although the phenomena which are now regarded as belonging exclusively to the spinal cord had been noticed long before the time of Gall, as *e. g.* to Prochaska and to Whytt; yet he appears to have been the first who adduced best proofs from anatomy to show that the spinal cord was *not* a mere appendage to the brain, but a special centre in itself. His principal arguments were derived from the want of any constant proportion in bulk between it and the brain, the spinal cord being small with a large brain, as in man, and large with a small brain, as in the inferior mammalia and in the vertebrata, and from the fact that it does not taper gradually as it gives off nerves. On this point, also, Sir. C. Bell, the founder of scientific neurology, as he has been justly termed, by "clearly marking out the distinction between the respiratory and voluntary movements, had given a most important indication." It would be unjust to the older physiologists not to allude to their share in this discovery. That both Whytt and Prochaska observed that a certain series of actions was still capable of being developed through the instrumentality of the whole cord or any portion of it, the nerves of which may remain uninjured both as to their central and peripheral connexions, there can be no doubt. The latter of these eminent men, (who were so very far in advance of their age,) remarked, and has related the fact, that when the hinder toes of a frog are wounded immediately after cutting off its head, there is either no motion at all excited in the muscles of the legs, or a very inconsiderable one; but if the toes of this animal be pinched or wounded with a pen-knife ten or fifteen minutes after decollation, the muscles, not only of the legs and thighs, but also of the trunk of the body, are for the most part strongly convulsed, and the frog sometimes moves from one place to another. The very fact of his noting and relating this shows clearly that he must have been aware of certain actions independent of the brain, since he describes them to have taken place after decapitation; but I think it is equally clear, by his observations with regard to the facts mentioned, that he was not aware that these actions were *independent of volition and sensation.* He regarded the spinal cord as a prolongation of the brain, and he attributed them no doubt to the influence of the mind, which he appears to have thought pervaded all parts of the body. It is, however,

to Dr. M. Hall that we are indebted for the revival of these observations, and for discovering that these physical nervous actions are entirely due and essentially belong to the spinal cord. This power in the cord exerts a wide influence on the phenomena displayed by living creatures, and medical science has been greatly enriched by this discovery. It would be out of place here to enter into controversial matters, and I shall confine myself, therefore, as much as possible, to pointing out how practical medicine has been promoted by this discovery of the reflex power in the cord; and for this we are indebted chiefly to the labours of Dr. M. Hall. In saying this, I must not omit to pass an eulogium, which is eminently due to Dr. Todd and Mr. Bowman, for their labours in this field of inquiry, and especially to the former, for his elaborate and learned essay on the nervous system in the "Cyclopædia of Anatomy and Physiology." Before Dr. M. Hall's discovery, physicians had been, from a very remote period, familiar with the fact, that severe affections, as *e. g.* convulsions, were sometimes entirely brought on, and that others were exacerbated by the presence of irritating matters in the stomach and intestines, and by dentition; and the practice was in force of removing these irritating matters in the one case by laxatives, and the pain and irritation accompanying the eruption of the teeth in the other case by lancing the gums. This practice was, however, entirely empirical. No clear conception was entertained of the precise way in which these sources of irritation acted, nor of that by which the remedies were effectual in removing the convulsions until his discoveries. He it was who placed this on an intelligible footing. He divided—and his division is a natural one—nervous morbid actions into two kinds, namely, 1st, into those which affected the brain, the seat of intelligence, volition, and consciousness; and, 2ndly, those which had their seat in the spinal cord and medulla oblongata, considered as a special centre. These last he again subdivided into reflex or eccentric, and into centric—the latter comprising those which arise from any source of irritation in their true special centre, as a morbid condition of the blood, as in asphyxia, poisoning, &c., the irritation of an inflamed arachnoid, or of effusion, of a tumour, or of exostosis of the spinal canal, &c.: the former, or eccentric, or those acting upon and through the centre, ineluding those arising from the application of any causes of irritation to the *incident* nerves, producing reflex actions, as in the case of dentition, where the irritation is in the gums. In this case the incident nerves, or those going *to* the spinal cord and proceeding *from* the gums, the stomach, and from the intestines, denote the several sources of this malady: the condition of the hand, the foot, the larynx, and the diaphragm, and other muscles of inspiration, the gall-duct and ureter, and the sphincters of the rectum and bladder, denote the affection of these parts of the system through the medulla oblongata and the medulla spinalis, and the reflex nerves; and lastly, the brain becomes secondarily affected by congestion, as *the effect* of general convulsion. Thus, how clearly does this theory enable us to give a *rationale* of all the symptoms marking an attack of convulsions from dentition!

Another good example of a reflex or eccentric morbid action is to be found in that terrible affection, tetanus, or locked-jaw. The explanation of the development of this fearful malady, according to the reflex theory, is as follows:—A wound in the sole of the foot or ball of the thumb, or in some other situation favourable to the maintenance of prolonged irritation, is capable of exciting, through the incident or centripetal nerves, a particular region of the spinal cord, from which the state of excitement spreads so as to involve not only the whole cord, but part of the medulla

oblongata also; and in this state a large proportion of the motor nerves participate, so as to induce tonic contraction of the muscles they supply. Intestinal irritation is capable of producing a similar condition, which, if the irritation have not been allowed to remain too long, may be speedily removed by getting rid of the irritating cause. A striking instance of this is related by Dr. Todd :—" An unhealthy-looking girl, about fifteen years of age, was brought into King's College Hospital, suffering from severe tonic spasms of the muscles of the spine and lower extremities. The spasms were so powerful as to produce excessive paroxysms of opisthotonos, during which the trunk became bent like a bow, so that she rested on the back of her head and on her heels." Now, this painful and alarming attack of idiopathic tetanus was speedily removed by the use of a large clyster containing turpentine, which brought away the offending and irritating cause, viz. a large number of worms from the intestine.

From our present knowledge of the nervous system we are enabled, in affections of the nervous centres, to localize the sources of the phenomena presented to us. If there be much delirium, we conclude that the grey substance covering the hemispheres is directly or indirectly affected; if sensibility be impaired or lost, that the optic thalami are the seats of the lesion; if voluntary motion be impeded or suspended, that the corpora striata are the parts involved; and, lastly, if there be spasm of the glottis, difficult deglutition, or irregular acts of respiration, we at once refer them to some affection of the medulla oblongata. These, with others which I have not time further to detail, are some of the important results of discoveries made within the past few years. But these, great and important as they undoubtedly are, are comparatively small when contrasted with what the application of the microscope and organic chemistry to the structure and functions of the organs and tissues of the body has placed within our reach. The scientific precision lately given to our knowledge of many diseases by the employment of new methods of investigation, and the discoveries arising from them, is very striking when compared to the vagueness and uncertainty of former days. By our increased knowledge of the intimate structure of the liver and kidney, for example, we are enabled to appreciate abnormal states which the pathologist of former days would in vain have looked for under the old methods of investigation. It was impossible, in most cases of disease of these organs, except there was complete change of structure, or alteration of form, or disorganisation had taken place, to connect the symptoms during life with the states of these organs after death. The great source of difficulty in detecting morbid changes sufficient to account for death, and the cause of numberless instances where no sufficient cause could be found, was owing, no doubt, to not knowing the intimate structure of organs, and to not using the microscope in their examinations. It is impossible to explain or understand the morbid appearances of such organs as the liver and kidney, for example, without reference to their intimate structure. It has been truly said that, "in an organ whose texture is spongy as the lung, disease produces such striking changes, that we can at once distinguish their different forms, and thus learn to connect them with the symptoms observed during life; but, in organs naturally solid, and also nearly of the colour of the blood, as the liver and kidney, these changes, and especially the traces of the various kinds of congestion and inflammation, are far less obvious, and to detect and discriminate them requires a knowledge of their intimate structure which has only lately been obtained; and, even *with that* knowledge, a very close and minute inspection is necessary."* We are indebted almost entirely to the complete and philosophical

* Budd.

researches of Mr. Kiernan and Mr. Bowman for our present knowledge of the intimate structure of these organs; and since their important discoveries—the one on the structure of the liver, the other on that of the kidney—changes of structure have been detected which previously completely eluded the examination of pathologists, and an explanation given of various mortal diseases with a precision and particularity equal to that of any fact in natural science. For example, let us take adhesive inflammation of the liver—or cirrhosis, as it is called—what was the state of our knowledge of this disease, and the consequences to which it led after a longer or shorter period, before Mr. Kiernan's clear elucidation and explanation of them? All was doubtful—nothing was clearly known about it, although it was very commonly found. But mark the contrast. *Now* the *development* of this affection can be traced step by step from the first commencement of inflammation up to the thickening of the areolar tissue, the consequent pressure upon the minute twigs and branches of the portal vein, obliteration of the lobules, interruption to the portal circulation, retardation of the blood in the intestinal veins, ascites, and ultimately death. Mark the successive gradations, which, although there may be slight modifications or differences in the processes by which these changes are effected in different cases, according to the causes which may have been instrumental in producing them, yet are substantially the same, and known and traced with a certainty and precision unknown in pathology before Mr. Kiernan's researches. Let us again direct our attention to another disease of this organ—fatty degeneration; which, however, is not a fatal disease, because it seems not to interfere much with the function of the liver; for the colouring and other matters of the bile which would be detrimental and poisonous to the system are secreted, and pass off as usual. There is no jaundice—no congestion of the veins that feed the vena portæ—no obstruction, therefore, to the circulation through the liver; no pain or tenderness, such as are the case in the former disease. The outward characters of this disease have been long familiar to pathologists, and were ascribed to the interstitial deposition of uncombined fatty matter in the substance of the liver; but it was not known precisely in what state or in what parts of the organ the fat was deposited, until Mr. Bowman discovered, by microscopical examination in 1841, that it existed in the form of oil globules in the hepatic cells. There is another organ prone to a similar condition,—namely, fatty degeneration,—which, so far from being so innocent in its nature, is a very frequent cause of sudden death. I need scarcely say that I allude to fatty degeneration of the heart. In this case the microscope has revealed to us the exact seat of the fat, which is found to take the place of the essential element of muscular contractility. This information at once lays open to us the cause of death,—the heart loses the power of propelling the blood to the brain and spinal marrow, and the system at large,—the organs are insufficiently supplied with arterial blood, their vitality diminishes, and on any sudden and unusual exertion, the heart is inadequate even to propel the blood to this extent, its action stops, and mortal faintness is the consequence. Time warns me that I must not more fully enter upon the light which has been thrown upon medical science by minute investigation; but I will venture to occupy your attention for a few minutes in illustrating what I have stated by one other example furnished by the kidney, an organ which closely resembles the liver, in having a double circulation within it. The anatomy of this organ has been so clearly made out by Mr. Bowman, that it forms one of the most finished labours even of the past few years, teeming as they do in other

discoveries of the same kind. The secretion of urine, and the share which the different parts of its structure successively perform in it, are now as plainly seen by the understanding as if the process took place before our eyes. Already has this elucidation of the minute structure of this organ been the means of clearing up uncertainty, of dispelling a number of unsupported hypotheses, and of substituting a true and lucid explanation with regard to diseases of great interest. It was reserved for a physician of our own day to connect certain appearances found after death with certain states of the urine during life, which afforded a sure indication that death must take place at no distant period. The exact changes, however, were not known until Mr. Bowman's researches into the minute structure of the organ. Not only have his inquiries enabled us to trace the sequence of actions which characterise the progress of the disease, but to discover that it included three different forms of disease, one of which is very different, in every respect, from the other two—namely, acute and chronic desquamative nephritis, and fatty degeneration. By the microscopical examination of the urine during life, these several states may be detected with a precision and a certainty unknown in the investigation of disease in former times. In desquamative inflammation of the kidney, for example, blood-corpuscles, with epithelial cells in great numbers, partly free and partly entangled in cylindrical fibrinous casts of the urinary tubes, and very commonly crystals of lithic acid may be seen; and in fatty degeneration, in addition to these, we have, what is characteristic of the disease, the presence of oil in the epithelial cells, which are more or less distended with it. We hence distinguish this disease from the two forms of desquamative nephritis, and are enabled to form a certain prognosis during life as to the event; in the one case, the patient *may* recover; in the other, on the contrary, general dropsy, sooner or later ending in death, is the invariable result. Thus, as has been truly remarked, "it is as important to distinguish between acute and chronic nephritis, and fatty degeneration of the kidney, as it is to distinguish acute pneumonia or chronic bronchitis from tubercular disease of the lungs; and the diagnosis of renal disease may be made with as much ease and certainty by a microscopical examination of the urine, as that of pulmonary disease by ausculation and percussion of the chest."

The appearance of the epithelial cells in this formidable disease leads me to the consideration of a discovery, which, for its important practical consequences, is equal to, if it do not surpass any other, either in ancient or in modern days. I allude to that of cell-formation, for which we are indebted to Schleiden and Schwann. If we except Hunter, whose genius led him in advance of his age more than half a century, there were two leading errors among physiologists with regard to the dependence of organisation on the circulation,—one class affirming that parts wanting vascularity, like the epidermis or scarf-skin, were therefore inorganic; whilst the other, objecting to the position that any part of a living body could be otherwise than organised, contended that the vessels were the only agents by which this could be effected. Hunter clearly saw that the living principle exists in the several parts of the body, independently of the influence of the brain and of the circulation. At the present day, this is sought to be *educed as a principle*, the enunciation of which is, that organisation is essentially and invariably independent of vascularity—"that in all organised beings, whether vegetable or animal, vascularity is secondary and subordinate, not primary or essential; that it may, therefore, be altogether dispensed with, as it is affirmed as the fact not only in the lower plants and animals, where the absence of vessels

is admitted, but also in the early embryonic condition of all, including the highest classes of animals, the human being forming no exception. It fully explains what is also maintained, "that in morbid processes, involving acts of assimilation, deposition, and absorption, the agency of the vessels is, as in the normal state, indirect, and in subjection to other and preceding processes." In saying this, it must not be understood that the important actions which take place within the vascular system, and the share which they take in organisation, are undervalued. Not at all: these actions are better understood now than at any other time, and have a significance which they never had before. In establishing, however, this great principle of the independence of all the processes of organisation on vascularity, one most important element was wanting, namely, an apparatus superadded to the vessels, which were previously supposed to be the immediate agents of all secretion, absorption, and nutrition. This apparatus the great discoveries of Schleiden, Schwann, and Henle, have revealed to us. They have shown that *wherever* secretion, absorption, or nutrition was going on, *there* was organic membrane interposed, generally in the form of nucleated cells. These discoveries, taken with that of Dutrochet—that, if two liquids of different densities, and not inclined to combine chemically together, be placed on the opposite sides of a thin organic membrane, a double current is set up,—fully explain how these functions are accomplished.

These two discoveries have then supplied the link that was wanting. There can be no question,—it has been proved to demonstration by the researches of Purkinje, who first propounded the doctrine, which Henle adopted and carried out, and which Goodsir and Bowman have fully confirmed,—that these cells are the real agents of secretion, absorption, and nutrition, which processes are all intimately associated together, and more or less dependent on each other. These cells are the first forms that are seen in the early embryo, they form the first elements of every tissue, and they enact the same important processes in vegetative as in animal development and growth. It is impossible as yet to imagine what will be the full results of this discovery to physiology and practical medicine; and the mind is lost in amazement at the wonderful properties possessed by these *apparently* insignificant forms. What is most calculated to excite our surprise is, the elective choice which these minute forms exercise; that while the composition of their walls is apparently and chemically the same, the cells are *potentially* different, separating from the blood the constituents of bile in the liver, those of urine in the kidney, and those of other secretions in their respective organs. It has been remarked by a writer on this subject, that the contents of the cell-cavity have no relation whatever to the material of the cell-wall. Of this we have a remarkable example in the case of the algæ, where the contents of the cell-cavity are green; those of hæmatococci bright red; and in the simple fungi, such as the torula cerevisiæ or yeast-plant, they are colourless,—the contents of the two former being simply ternary compounds of water and carbon, the cell-contents of the yeast-plant being closely allied to the protein compounds; and yet the cell-walls in both instances are composed of the same material —*cellulose*. There is one important fact, however, regarding secretion, that in all glands they exhibit a certain type or character, which, from their constant presence in these organs, physiologists have given to these cells the name of glandular epithelium.

Besides clearing up the mist that so long hung over the process of secretion in glands, the offices of which were to a great extent made out, such as the liver, the kidney, and others having *excretory ducts*, by the

theory of cell-secretion, the offices performed in the economy by what are called vascular glands, such as the spleen, the thymus and thyroid glands, and supra-renal capsules, which have no excretory duct to direct us to the discovery of their function, already loom in our mental view. The processes performed by these bodies correspond so completely with the secreting operations in their general nature, as to render but little doubtful that they are true secreting glands. They are provided with what we have already found are the instruments by which secretion is effected, namely, cells,—the only difference being, that they are unprovided with excretory ducts for the discharge of the product of their operation. These products, instead of being carried *out* of the body, are destined to be *restored* to the *circulating* current, apparently in a state of more complete adaptiveness to the wants of the nutritive function; or, "in other words, these vascular glands are concerned in the assimilation of the materials that are destined to be converted into organised tissues, instead of being the instruments of the removal from the body of the matters which result from the disintegration or decay of those tissues." These cells, then,—so apparently insignificant,—are the agents in building up the superstructure of the body,—these, imbedded in a matrix, and in the condition of simple molecules, in which, with the highest amplifying power which we can bring to bear upon them, we are unable to detect any distinction of parts, are endowed with a potential agency which scarcely any external influence can modify. By their original endowments, stamped upon their organisation, as if by the fiat of the Creator, they assume a definite direction in their future development and function which no external agency can divert,—the one set to construct the brain and nervous system; another, the osseous fabric; and another, the muscular; and so on in all other structures of the body. Such is a brief and, I fear, a very unsatisfactory account of some of the principal discoveries in physiology which have been made, chiefly by the assistance of the microscope, within the past few years, teeming as they do with others of great value to practical medicine and surgery.

Time will only permit me just to allude to the great assistance which organic chemistry has also contributed to the advancement of physiological and medical science In the words of a highly esteemed physiologist (Grainger—Hunterian Oration), "Owing to what organic chemistry has unfolded to us, we have a much clearer insight into the relations and interdependencies existing between the vital power, and the molecular and chemical constitution of their organic instruments, than had hitherto ever been obtained. Thus, in the vegetative existence, we can distinctly trace the new organic matters introduced into the interior of the system through many, and in not a few instances through all, their manifold and important changes, till at length, having served their purpose, and constituted for a time a component part of the machine, they are cast out to be replaced by new supplies." That there is an incessant molecular destruction, or, to speak more correctly, mutation of the living body, is, indeed, no new truth, since it has been known from the infancy of science. "Life," to borrow the eloquent language of Cuvier, "is a continual vortex, of which the direction, all complex as it is, remains constant, as well as the kind of molecules propelled by it; but not so the individual molecules themselves; these change without cessation, so that the actual matter of a living body, although it is the depository of forces which will constrain future matter to march in the same direction with itself, will soon be there no longer." But it is a very different thing to know the general fact of this eternal change, and to be able, as we now are, by the aid of organic chemistry, to trace each act of the metamorphosis—to be able precisely to

define what becomes of the saccharine and fatty principles of the food—to be able to follow the albuminoid matters, the phosphorus, the earthy, the alkaloid, and the metallic salts—to have a clear perception to what particular class of organs they go—how they are used up in the production of different kinds of force, or in the formation of various secretions; and, finally, to find in the very *debris* and excreta of the body the sure and certain measure of the vital action itself. It is a great fact to know that no force is generated, that no heat is evolved, that no motor power is produced, that no nervous action takes place, nay, that even no thought passes through the mind, without equivalent changes in the form of the organised materials of the frame. The physiologist obtains thereby a clearness of conception as to the most occult processes of life, which is strongly felt by all who possess it, but which, in the absence of all the extended knowledge out of which it springs, is difficult to convey to others by mere description. He is, for example, by one simple distinction, thus enabled to separate the multitudinous organs of the animal body—leaving out of the category, for the moment, the mere preparing organs, like the glands —into two broad and distinct classes, according as they are the generators, or the mere recipients or transmitters of force; he readily recognises the cause of the large supply of blood sent to the producer of the motive force, the muscle, and the comparative absence of vascularity in the mere passive organs of locomotion; and in this way is prepared that beautiful instance of design revealed by the microscope—the looping back and the return of the blood-vessels, when, reaching the end of the muscle, they refuse to enter its tendinous appendage; and further, even when passing to such a subordinate group of organs as the bones, cartilage, and tendons, he finds, in the precise parts they have respectively to perform, the reason of the varying supplies of nutrient matter they demand and receive. All these principles, which have given an interest and a meaning to chemistry, as applied to the analysis of animal structures, it never before possessed, are among the highest truths of organic science; and it is now plainly seen, must, in all subsequent time, constitute one of the prime means of interpreting vital phenomena, whether these be healthy or morbid.

Such is a brief *résumé* of what organic chemistry has done for physiology and medicine, and is still calculated to do, and there can be no doubt that every year will be marked with fresh proofs of the power of organic chemistry still further to elucidate the composition and functions of the tissues and organs of the body. I would earnestly impress upon you, who are now passing your pupilage in this hospital, the great importance of making yourselves acquainted with the present state of physiology; and one great object in bringing before you a few of the discoveries in this branch of science during the past few years, is to place before you the great influence which these have exercised in advancing our knowledge of practical medicine. I look upon it that physiology forms the most substantial, indeed, I may say, the only true foundation of medicine and surgery, and that without a knowledge of it, it is impossible to understand the principles of either. The more extensive is our acquaintance with the actions of the body in a state of health, the more competent shall we be to detect and to appreciate any alterations in them occasioned by disease; and for a proper understanding of physiology, we must be accurately and practically acquainted with the intimate structure of the organs and tissues of the body Believe me, the labour of studying the minute structure of organs is much over-rated; but whatever it may be, it will be amply repaid to you in the pleasure and value of the knowledge so possessed. There is such a beautiful simplicity in

these structures, and such a close general resemblance, that the difficulty is only felt at the commencement. In a short time the mists with which you first found yourselves surrounded will one by one clear away, and you will be surprised and delighted at finding the simplicity and unity prevailing. In former days (I speak of twenty years ago), the method in practice of studying anatomy was peculiarly uninteresting and forbidding. The memory was burdened by a number of unconnected facts, having no reference to any physiological, or even surgical application. Now structure and function are so associated as to give the study of it an ever-increasing interest.

As there are many here present who are now about to commence their studies at this school, I should wish to engage their attention for a few moments. It would be altogether unnecessary to state here the regulations of the College of Surgeons and the Apothecaries' Society, since you will have to make yourselves acquainted with them through the ordinary channels of such information. Both the College of Surgeons and the Apothecaries' Society very wisely lay a great stress upon the study of anatomy and physiology; and the latter body, to which the medical profession, as well as the public generally, owe a deep debt of gratitude for the great improvements which it has been the means of introducing in medical education, has issued a curriculum which, in all its parts is the most perfect that could have been framed, and a copy of which I would advise each of you to procure for yourselves: I would recommend you also attentively to read the preface to it. You can have no better general guide. And now, gentlemen, with regard to the relative position of lecturers and pupils at this school, we are fully sensible that we should be imperfectly acting up to the spirit of the regulations of the licensing bodies, if we allowed our duties to the pupils to terminate in the lecture-room. Not that we would undervalue the utility of lectures: they are no doubt of great use, indispensable, in fact,—as affording an opportunity of bringing the subject in a connected form, and in its totality, before the student. But, in addition to lecturers, we wish to be regarded in every respect as your teachers,—your tutors,—ready and anxious to assist you under all difficulties,—to explain subjects which you find any difficulty in understanding —and to make our explanations clear to you by dissection, experiment, microscopical examination, as the subject may require. Lastly,—and in a word,—it is our wish to be considered by you in every respect in the light of older and more experienced friends.

CARLISLE:
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